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Review of experiments and calculations of the compressible Richtmyer-Meshkov instability from a single-mode, nonlinear initial perturbation

(Key Letter A)

T. A. Peyser, P. L. Miller, D. R. Farley, L. M. Logory, P. E. Stry and E.W. Burke

Lawrence Livermore National Laboratory
P. O. Box 808, L-22
Livermore, California 94551 USA

We review experiments and calculations of the compressible Richtmyer-Meshkov instability from a single-mode, nonlinear initial perturbation. These experiments were performed using the Nova laser and reported at this meeting two years ago.[1]In those experiments, we reported measurements of the time-evolution of the mixing region. We compared the experimental measurements with numerical simulations usingh CALE, a two-dimensional arbitrary Lagrangian-Eulerian hydrodynamics code. We found both experiment and simulation to be in good agreement with recent theories for the nonlinear evolution of the instability.[2,3]

Experimental results beyond those presented at the 5th International Workshop on the 10 μm amplitude, 23 μm wavelength sawtooth perturbation provide additional support for the use of two phase flow models to describe the flow in the nonlinear regime. These experiments include measurement of the mixing region at earlier times than previously reported as well as experiments with high opacity tracer layers in the heavy and light fluid to better visualize the spike and bubble amplitudes. We have also carried out experiments to examine the effect of circular groove versus linear perturbations. Two-dimensional simulations have approximated the experimental linear grooves as circular grooves. We reasoned that the difference between the two cases would be small, based on scaling arguments, and limited to a very small region near the centerline. The experimental results confirm this. We compare the experimental data and simulated radiographs to the spike and bubble structure in the CALE calculations. Finally, we present some preliminary experiments on spike and bubble merger from similar, scaled Richtmyer-Meshkov experiments consisting of large amplitude sawtooth grooves. These new experiments are intermediate in scale between the high-speed jet

experiments reported previously by Miller et al.[4] and the Richtmyer-Meshkov experiments discussed elsewhere in this conference [5,6].

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